**The force of friction**

Friction is a force that makes things change.

1. Look at each picture.

Which arrow shows the force of friction?

|  |  |
| --- | --- |
| a.  Arrow A 🞏  Arrow B 🞏 | b.  Arrow A 🞏 Arrow B 🞏 |
| c.  Arrow A 🞏  Arrow B 🞏 | d.  Arrow A 🞏  Arrow B 🞏 |

1. What do you think about the force of friction?

For each statement, tick (✓) **one** column to show what you think.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Statements** | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | Friction can slow down moving objects |  |  |  |  |
| **B** | Friction pushes in the opposite direction to movement |  |  |  |  |
| **C** | Friction **only** pushes when there is movement |  |  |  |  |

*Physics > Big idea PFM: Forces and motion > Topic PFM1: Forces > Key concept PFM1.4: Friction*

|  |
| --- |
| **Diagnostic question** |
| **The force of friction** |

**Overview**

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| --- | --- |
| Learning focus: | Friction is a force generated by an interaction between two surfaces, and which acts to resist movement between them. |
| Observable learning outcome: | * Describe the effect of the force of friction on an object. |
| Question type: | Diagnostic, simple multiple choice, confidence grid |
| Key words: | Friction, force, direction |

**What does the research say?**

Friction is the force generated *by* an interaction between two objects. This is different to most forces which *cause* the interaction (Hart, 2002). This perhaps led to the finding from a study of thirty-eight 12-16 year olds, that fewer than half of students identify friction as a force (Stead and Osborne, 1980). Driver *et al* (1994) suggest that many students think of forces only as ‘getting things going’ and not as ‘stopping things’.

A later study of forty-seven secondary students, by Stead and Osborne (1981), showed that students also think that:

* friction depends on movement (seventeen students)
* friction is directionless, as distinct from a force that opposes motion (a few students)

The first part of this diagnostic question introduces students to the idea of thinking about friction in the same way as other forces, and challenges them to identify the direction in which the *force* of friction is acting in. The second part of the question identifies those students with common misunderstandings about friction.

**Ways to use this question**

Students should complete the questions individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

Differentiation

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

*Multiple choice answers:* Slide: B, car: B, jar B, runner, A

*Confidence grid answers:* A and B are right, and C is wrong

**How to respond - what next?**

*Multiple choice*

Friction caused by rubbing slows down the person on the slide and the car.

The jar lid may not be moving, but friction acts in the opposite direction to the movement, or attempted movement.

The runner is the example which most students have difficulty with because when they think about running they imagine pushing themselves forwards. In fact running involves pushing backwards on the ground. The friction generated pushes forwards to stop the runner’s feet from slipping.

If students do not fully understand this, then it may be helpful to ask them to imagine running forwards on a loose rug and decide which way the rug would be pushed (backwards). Alternatively they could think about which way they would need to push on someone to make them move forwards. When running the only place to push on the runner is at their contact points with the ground, and the only force the ground can push forward with is the friction *generated* by the runner pushing backwards.

*Confidence grid*

Friction slows down moving objects because of the rubbing between two objects, and it always acts in the opposite direction to the movement. This is because the friction is generated in response to the motion.

A common misunderstanding is that when there is no movement, there is no friction. If students have difficulty in understanding this, it may help to ask them to consider the forces they experience when standing on a very steep slope. Giving them the opportunity to think about this in pairs or small groups would encourage social construction of new ideas through dialogue.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: UYSEG

**References**

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